

HUC 11070208 – Elk River  
Water body IDs: 3259/3260/3263  
303(d) Listing: Escherichia coli



**Total Maximum Daily Load  
Implementation Strategies  
for the  
North, Middle, and South Indian Creek Watersheds  
Newton and McDonald Counties, MO**

**Pollutants: *Escherichia coli* and Nutrients**

**Completed:** March 3, 2021

## WATER BODY SUMMARY

### Total Maximum Daily Loads (TMDL) for North, Middle, and South Indian Creeks

**Names:** North Indian Creek  
Middle Indian Creek  
South Indian Creek

**Location:** Newton and McDonald counties

**8-digit Hydrologic Unit Code (HUC):<sup>1</sup>**  
11070208 – Elk River

**12-digit HUC Subwatersheds**  
110702080301 – North Indian Creek  
110702080302 – South Indian Creek

**Water Body Identification Number (WBID) and Hydrologic Class:<sup>2</sup>**  
3260/3263/3259 - Class P

**Designated Uses:<sup>3</sup>**

Irrigation  
Livestock and wildlife protection  
Human health protection  
Warm water habitat (aquatic life)  
Cold water habitat (WBID 3259 only)  
Whole body contact recreation category B  
Secondary contact recreation

**Impaired Use:**

Whole body contact recreation category B  
Warm water habitat (aquatic life)

**Pollutants Addressed through TMDLs:**

*Escherichia coli* (*E. coli*) (fecal indicator bacteria)  
Nutrients (Elk River Basin)

**Length and Location of Impaired Segments:**

North Indian Creek (WBID 3260): 5.2 miles, from Section 24, Township 24N, Range 31W to  
Section 36, Township 25N, Range 30W

Middle Indian Creek (WBID 3263): 2.2 miles, from mouth to Section 16, Township 24N, Range 30W

South Indian Creek (WBID 3259): 8.7 miles, from mouth to Section 1, Township 23N, Range 30W



Location of watershed in Missouri

<sup>1</sup> Watersheds are delineated by the U.S. Geological Survey using a nationwide system based on surface hydrologic features. This system divides the country into 2,270 8-digit hydrologic units (USGS 2019). A hydrologic unit is a drainage area delineated to nest in a multilevel, hierarchical drainage system. A hydrologic unit code is the numerical identifier of a specific hydrologic unit consisting of a 2-digit sequence for each specific level within the delineation hierarchy (FGDC 2003).

<sup>2</sup> For hydrologic classes see 10 CSR 20-7.031(1)(F). Class P streams maintain permanent flow even in drought periods.

<sup>3</sup> For designated uses see 10 CSR 20-7.031(1)(C) and 10 CSR 20-7.031 Table H. Presumed uses are assigned per 10 CSR 20-7.031(2)(A) and (B) and are reflected in the Missouri Use Designation Dataset described at 10 CSR 20-7.031(2)(E).

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## 1. Introduction

A total maximum daily load (TMDL) report for North, Middle, and South Indian Creeks addresses elevated *Escherichia coli* (*E. coli*) bacteria concentrations that resulted in the water body's placement on Missouri's 303(d) List of Impaired Waters. The TMDLs established for the impaired water bodies represent the *E. coli* loading capacity for each stream, which is the maximum amount of a pollutant that a water body can assimilate and still attain and maintain water quality standards. Watershed characteristics and *E. coli* loading targets can be found in the TMDL report, which is available on the Missouri Department of Natural Resources' website at [dnr.mo.gov/env/wpp/tmdl/3259-3260-3263-north-middle-south-indian-creek-water-body-record.htm](http://dnr.mo.gov/env/wpp/tmdl/3259-3260-3263-north-middle-south-indian-creek-water-body-record.htm). Although this implementation document is drafted primarily to implement the goals of the *E. coli* TMDL, North, Middle, and South Indian Creeks are also included in the Elk River Basin Nutrient TMDL (Approved in 2004), which can be accessed at [dnr.mo.gov/env/wpp/tmdl/docs/3246-elk-r-tmdl.pdf](http://dnr.mo.gov/env/wpp/tmdl/docs/3246-elk-r-tmdl.pdf). Many of the practices suggested in this document will reduce both *E. coli* and nutrient loading. Questions regarding the TMDLs may be sent via email to [tmdl@dnr.mo.gov](mailto:tmdl@dnr.mo.gov) or by calling the Department's Watershed Protection Section at 573-751-5723.

This implementation strategies document is a companion to the TMDL reports and suggests actions that will reduce pollutant loading in order to meet the loading capacities established in the TMDL documents. The goal of the TMDLs is to attain and maintain designated uses in the waterbodies. The warm water habitat (aquatic life) and whole body contact recreation category B uses are impaired in North, Middle, and South Indian Creeks due to elevated *E. coli* concentrations in the water bodies.

This document neither prescribes nor prohibits any specific practices or technologies for reducing pollutant loading in the impaired water body and is not intended to serve as the sole means of remediation and restoration. However, the Department recognizes that technical guidance and support are critical to achieving the goals of any TMDL. Therefore, while the TMDL calculates the maximum pollutant loading that the impaired stream can assimilate and still attain and maintain water quality standards, this strategies document provides additional information to assist in meeting the TMDL loading goals including: pollutant reduction strategies, example calculations of pollutant reductions, potential participants in the watershed, and funding sources. Because the TMDL addresses pollutant loading from all potential sources in the watershed, this strategies document provides guidance for meeting the loading targets assigned to both point and nonpoint sources.<sup>4</sup>

Point source pollutant loading controls are implemented primarily through the Missouri State Operating Permit program.<sup>5</sup> Effluent limits are established in facility permits based on the assumptions and requirements of the wasteload allocations and other recommendations in the TMDL documents. Cost-share loans are available from the State Revolving Fund and are administered through the Department's Financial Assistance Center to help finance facility upgrades that are necessary to meet more stringent effluent limits.

Watershed management practices that reduce nonpoint source pollutant loading are conducted voluntarily by interested stakeholders and landowners within the watersheds. In accordance with

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<sup>4</sup> Point and nonpoint sources are defined and discussed in Sections 5.1 and 5.2 of the TMDL report for North, Middle, and South Indian Creeks and throughout the TMDL report for the Elk River Basin.

<sup>5</sup> The Missouri State Operating system is Missouri's program for administering the federal National Pollutant Discharge Elimination System (NPDES) program. The NPDES program requires all point sources that discharge pollutants to waters of the United States to obtain a permit. Issued and proposed operating permits are available online at [dnr.mo.gov/env/wpp/permits/index.html](http://dnr.mo.gov/env/wpp/permits/index.html).

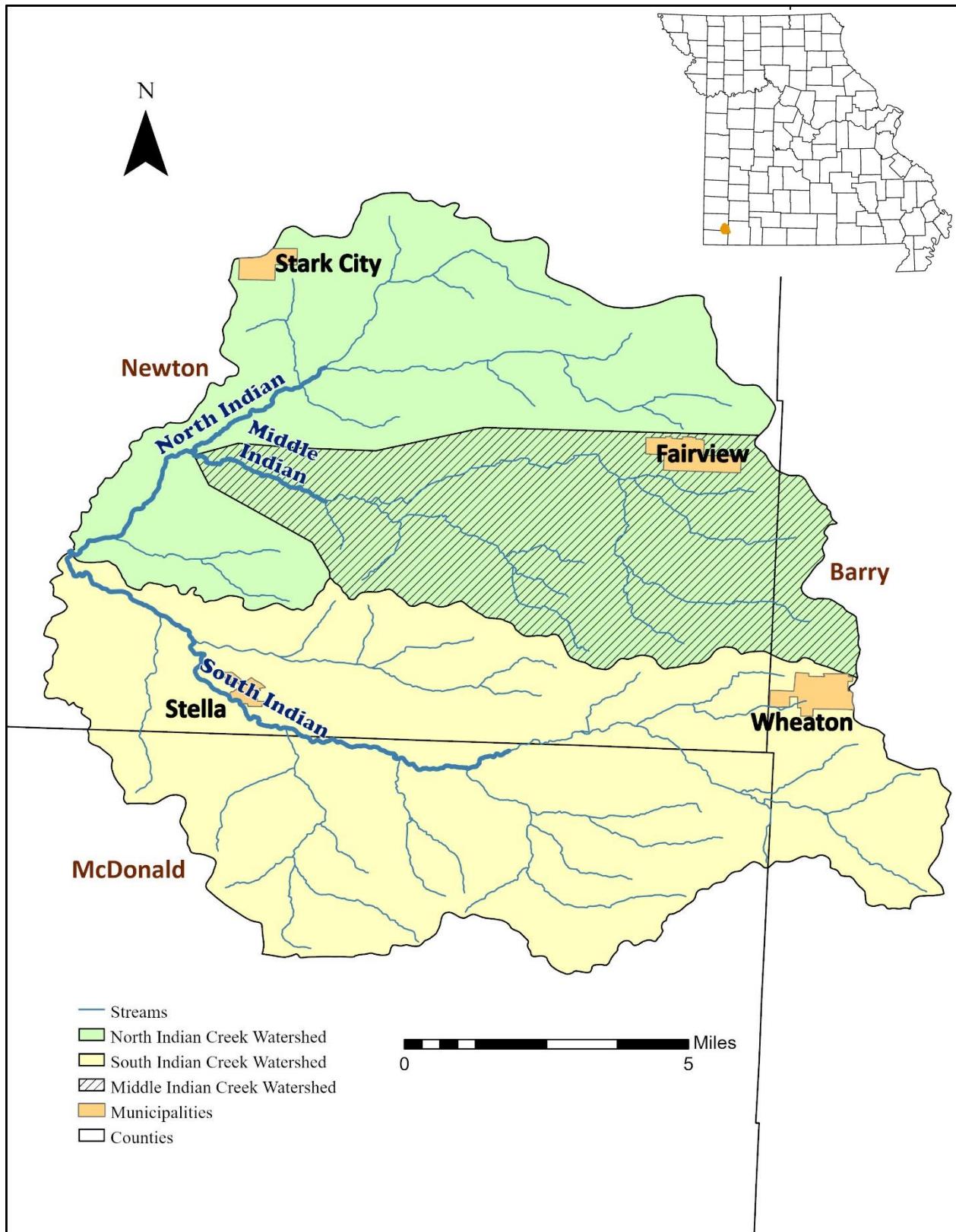
Section 319 of the federal Clean Water Act, the U.S. Environmental Protection Agency (EPA) provides funding for nonpoint source pollutant load reduction practices. Section 319 nonpoint source subgrants are administered through Missouri's Section 319 program to assist organizations with watershed planning or implementation of activities as described in a Nine Element Watershed Management Plan (or alternative plan under certain specific conditions) that has been accepted by the Department and EPA. The Nine Key Elements of a Watershed Management Plan are provided in Appendix A. More information on Missouri's Section 319 subgrant program is available at: <https://dnr.mo.gov/env/swcp/nps/319nps-proj-req.htm>. Local communities and citizens looking to develop organized watershed groups to improve water quality are encouraged to contact the University of Missouri Extension at 573-882-0085. Information regarding the University Extension's water quality program is available online at [fsb.missouri.edu/extension/water-quality/](http://fsb.missouri.edu/extension/water-quality/). Additional cooperating organizations and sources of funding are provided in Section 10 of this document.

## **2. Watershed Characteristics**

North, Middle, and South Indian Creeks are located in southwest Missouri within the Elk River subbasin, which is cataloged by the U.S. Geological Survey (USGS) as the 8-digit hydrologic unit code (HUC) 11070208. Within this subbasin, the North Indian Creek 12-digit HUC watershed (110702080301) is 48.0 square miles and the South Indian Creek 12-digit HUC watershed (110702080302) is 48.7 square miles. Within the North Indian Creek watershed, the Middle Indian Creek watershed is 22.5 square miles. North Indian Creek originates in southeastern Newton County and flows south for 5.2 miles to Indian Creek. Middle Indian Creek is a tributary to North Indian Creek and extends 2.2 miles upstream from their confluence. South Indian Creek originates in northeastern McDonald County and flows northwest to Indian Creek. North and South Indian Creeks converge at their confluence with Indian Creek (Figure 1).

The North, Middle, and South Indian Creek watersheds are located within the Springfield Plateau and Elk River Hills EPA Level IV ecoregions, which are underlain by a high number of limestone formations. Local relief is relatively high (150 to 250 feet in elevation), and cliffs and streamside bluffs are common. Steep slopes combined with moderate to slow soil infiltration rates results in frequent flash-flooding during and after intense rainfall events (MoRAP 2005).

Land cover types present in the North, Middle, and South Indian Creek watersheds are summarized in Tables 1, 2, and 3. Figure 2 depicts the distribution of the land cover types throughout the watershed. Grassland and pasture areas potentially used for livestock grazing cover the majority of all three watersheds.



**Figure 1. Location of the North, Middle, and South Indian Creek Watersheds**

**Table 1. Land Cover in the North Indian Creek Watershed**

Land Cover Type	Area (mi <sup>2</sup> )	Percent
Developed, High Intensity	0.03	0.06%
Developed, Medium Intensity	0.28	0.57%
Developed, Low Intensity	0.34	0.71%
Developed, Open Space	2.13	4.43%
Barren Land	0.03	0.06%
Cultivated Crops	4.16	8.67%
Grassland and Pasture	34.39	71.63%
Shrub and Herbaceous	0.33	0.68%
Forest	6.25	13.02%
Wetlands	0.06	0.13%
Total	48.00	100.00%

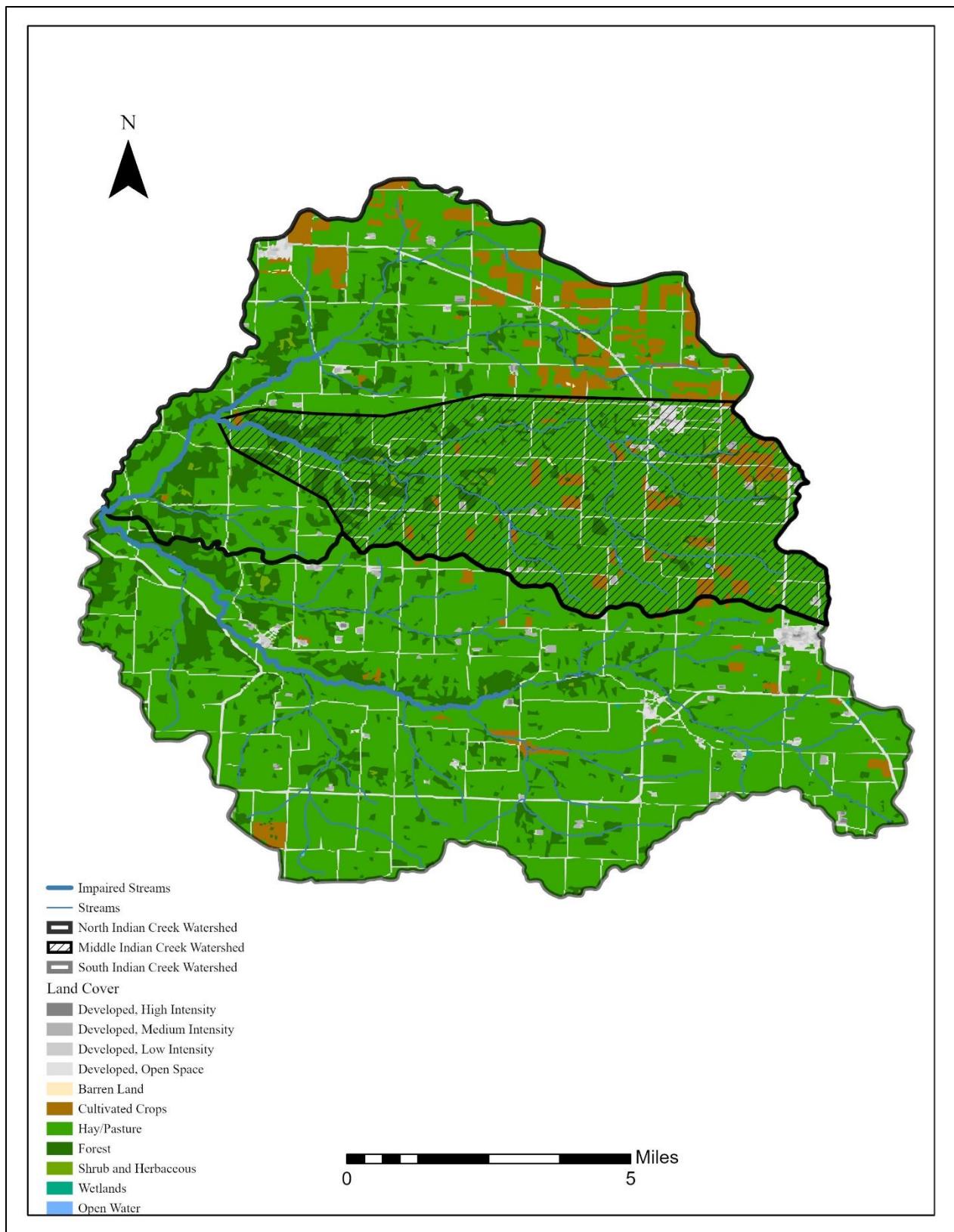
**Table 2. Land Cover in the Middle Indian Creek Watershed**

Land Cover Type	Area (mi <sup>2</sup> )	Percent
Developed, High Intensity	0.02	0.07%
Developed, Medium Intensity	0.14	0.62%
Developed, Low Intensity	0.14	0.61%
Developed, Open Space	1.02	4.56%
Barren Land	0.01	0.05%
Cultivated Crops	1.27	5.65%
Grassland and Pasture	17.01	75.78%
Shrub and Herbaceous	0.22	0.97%
Forest	2.59	11.53%
Wetlands	0.02	0.10%
Total	22.43	100.00%

**Table 3. Land Cover in the South Indian Creek Watershed**

Land Cover Type	Area (mi <sup>2</sup> )	Percent
Developed, High Intensity	0.034	0.07%
Developed, Medium Intensity	0.334	0.69%
Developed, Low Intensity	0.318	0.65%
Developed, Open Space	2.604	5.35%
Barren Land	0.003	0.01%
Cultivated Crops	0.697	1.43%
Grassland and Pasture	38.714	79.52%
Shrub and Herbaceous	0.092	0.19%
Forest	5.694	11.69%
Wetlands	0.166	0.34%
Total	48.66	100.00%

Implementation Strategies for North, Middle, and South Indian Creek *E. coli* TMDL



**Figure 2. Land Cover in North, Middle, and South Indian Creek Watersheds**

### 3. Water Quality Impairments

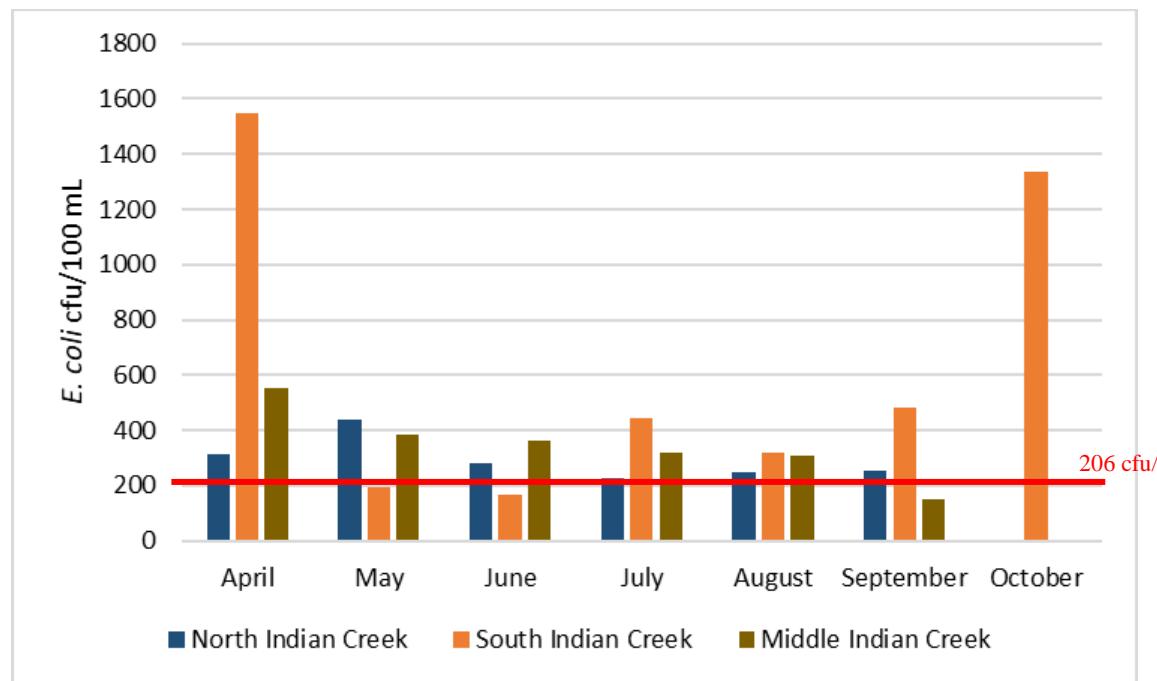
Water quality criteria are limits on certain chemicals or conditions in a water body established to protect designated uses. The whole body contact recreation category B designated use is impaired due to high *E. coli* bacteria concentrations in North, Middle, and South Indian Creeks. Whole body contact recreation includes activities that involve direct human contact with waters of the state to the point of complete body submergence (10 CFR 20-7.031(1)(C)2.A.). During such activities, such as swimming, accidental ingestion of the water may occur and there is direct contact to sensitive body organs, such as the eyes, ears, and nose. Whole body contact category A applies to waters that have been established by the property owner as public swimming areas welcoming access by the public for swimming purposes and waters with documented existing whole body contact recreation uses by the public (10 CSR 20-7.031(1)(C)2.A.(I)). Whole body contact category B applies to waters designated for whole body contact recreation not contained within category A (10 CSR 20-7.031(1)(C)2.A.(II)). Secondary contact recreation, which includes activities such as boating, fishing, and wading, are activities that may result in contact with the water that is either incidental or accidental and the probability of ingesting appreciable quantities of water is minimal (10 CSR 20-7.031(1)(C)2.B.). The secondary contact recreation uses are not impaired in North, Middle, or South Indian Creeks.

Specific numeric *E. coli* bacteria criteria are given in Missouri's Water Quality Standards at 10 CSR 20-7.031(5)(C) and Table A1. *E. coli* are bacteria found in the intestines of humans and warm-blooded animals and are used as indicators of potential fecal contamination and risk of pathogen-induced illness to humans. For category B waters, *E. coli* during the recreational season (April through October) shall not exceed the geometric mean of 206 colony forming units (cfu) per 100 milliliters (mL) of water. This criterion is also protective of the secondary contact recreation designated use because the *E. coli* criterion for the protection of secondary contact recreation is a recreational season geometric mean that does not exceed 1,134 cfu/100 mL of water. The Department determines that a stream is impaired for *E. coli* bacteria when the water quality criteria are exceeded in any of the last three years for which there is a minimum of five samples collected during the recreational season. This approach is detailed in the Department's 2020 Listing Methodology Document, which is available online at [dnr.mo.gov/env/wpp/waterquality/303d/303d.htm](http://dnr.mo.gov/env/wpp/waterquality/303d/303d.htm).

The geometric means of recreational season *E. coli* data used to assess water quality in North, Middle, and South Indian Creeks are displayed in Table 4 and Figure 3. As shown, *E. coli* concentrations exceeded the geometric mean of 206 cfu/100 mL during the recreational season (April through October) in North and Middle Indian Creeks in 2007, and South Indian Creek in 2007 and 2012.

**Table 4. Summary of Recreational Season *E. coli* Data for the Impaired Water Bodies**

Water Body	Recreational Season	Number of Samples	Minimum (cfu/100 mL)	Maximum (cfu/100 mL)	Geometric Mean (cfu/100 mL)
South Indian Creek	2007	97	1.0	4,839	270
	2012	6	33.6	4,106	382
	2013	13	13.1	738	128
North Indian Creek	2007	24	90.6	1,046	280
Middle Indian Creek	2007	25	98.8	1,046	325



**Figure 3. Geometric Means of *E. coli* Data by Month**

## 4. Causes and Sources of Pollutant Loads

### 4.1 Agricultural Areas

Croplands, pasturelands, and low-density animal feeding operations are potential sources of bacteria in surface waters. Bacteria are transported in runoff from areas fertilized with animal manure and where livestock are present. Runoff can result from precipitation or excessive irrigation. Section 640.760 RSMo establishes setback distances for surface application of liquefied manure from a CAFO by a third party.<sup>6</sup> Pursuant to Section 640.760 RSMo, the Department may enforce stricter setbacks. Soil and Water Conservation Districts provide funding and guidance for the development of nutrient management plans for private lands. Areas where nutrient management plans guide manure application and where best management practices are used to reduce soil erosion contribute less bacteria to surface waters than unmanaged areas. Although grazing areas are typically well vegetated, livestock tend to congregate near feeding and watering areas and create barren areas that are susceptible to erosion (Sutton 1990). Livestock that are not excluded from streams deposit manure and thus bacteria directly into waterways.

As shown previously in Tables 1, 2, and 3, and Figure 2, the North, Middle, and South Indian Creek watersheds are dominated by grassland and pasture, with a total of 73 square miles potentially grazed by livestock. Aside from livestock present in permitted CAFOs, the exact type and number of livestock present in the North, Middle, and South Indian Creek watersheds are unknown. Since there are no cattle CAFOs in the watersheds, the number of cattle in each watershed can be estimated from

<sup>6</sup> Section 640.760 RSMo setback distances are: 50 feet from a property boundary, 300 feet from any public drinking water lake, 300 feet from any public drinking water intake structure, 100 feet from any perennial and intermittent streams without vegetation abutting such streams, and 35 feet from any perennial and intermittent streams with vegetation abutting such streams.

county cattle population numbers provided in the U.S. Department of Agriculture's 2017 Census of Agriculture (NASS 2017). Based on the 2017 agricultural census there are an average of 121.3 cows per square mile of grassland or pasture in Newton, McDonald, and Barry counties.<sup>7</sup> This indicates that there are 4,172 cows in the North Indian Creek watershed, 2,063 of which are in the Middle Indian Creek watershed, and 4,696 cows in the South Indian Creek watershed. The U.S. Department of Agriculture estimates that a 1,000-pound beef cow produces approximately 59.1 pounds (26.8 kilograms) of manure per day (USDA 1995). Another study found that 1 gram of fresh manure from a cow on pasture contains a population of approximately 758,577 *E. coli* (Weaver et al. 2005). A single *E. coli* cell can grow into a colony containing  $10^8$  cells every 12 hours (Lodish et al. 2000). This means that each 1,000-pound cow has the potential to produce 422 colony forming units per day. Other types of livestock such as horses and sheep may also be contributing bacteria loads in the North, Middle, and South Indian Creek watersheds. The number and distribution of other animals in the watershed is unknown.

#### **4.2 Riparian Corridor Conditions**

Wooded riparian buffers are a vital functional component of stream ecosystems and are instrumental in the detention, removal, and assimilation of pollutants in runoff. As displayed in Tables 5, 6, and 7 over 30 percent of the North and Middle Indian Creek riparian corridors (100-foot buffer) and over 20 percent of the South Indian Creek riparian corridor are forested, which indicates that some of the *E. coli* that may be transported from adjacent cropland and pasture lands into those areas is intercepted before it enters the creeks. Grassland and pasture areas constitute over 57 percent of the North and Middle Indian Creek riparian corridors and nearly 70 percent of the South Indian Creek riparian corridor. Runoff from those areas may transport substantial *E. coli* into the streams. Grassland and pasture areas are adjacent to 160,916 linear feet of North Indian Creek and its tributaries. Of that, 74,817 linear feet is adjacent to Middle Indian Creek and its tributaries. Grassland and pasture areas are adjacent to 234,574 linear feet of South Indian Creek and its tributaries. Although cropland covers much less of each watershed than grassland and pasture, a total of 7,116 linear feet of streams in the watersheds are adjacent to cropland.

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<sup>7</sup> This analysis assumes all areas identified as grassland or pasture are being used for cattle grazing and that cattle are evenly distributed among those areas. Additionally, although some animals may be confined in some areas, for purposes of this estimation the entire cattle population was assumed to be grazing on hay and pasture areas.

**Table 5. Land Cover in the Riparian Corridor of North Indian Creek and Tributaries**

Land Cover Type	Riparian Corridor Land Cover Type Area	
	Acres	Percent
Developed, Low Intensity	0.66	0.05%
Developed, Medium Intensity	0.21	0.02%
Developed, Open Space	48.37	3.56%
Cultivated Crops	23.53	1.73%
Grassland and Pasture	783.97	57.63%
Forest	471.24	34.64%
Shrub and Herbaceous	16.12	1.19%
Wetlands	14.00	1.03%
Open Water	2.18	0.16%
<b>Total:</b>	1360.29	100.00%

**Table 6. Land Cover in the Riparian Corridor of Middle Indian Creek and Tributaries**

Land Cover Type	Riparian Corridor Land Cover Type Area	
	Acres	Percent
Developed, Low Intensity	0.36	0.05%
Developed, Medium Intensity	0.01	0.00%
Developed, Open Space	15.51	2.38%
Cultivated Crops	7.94	1.22%
Grassland and Pasture	373.63	57.30%
Forest	236.86	36.33%
Shrub and Herbaceous	8.98	1.38%
Wetlands	6.54	1.00%
Open Water	2.18	0.33%
<b>Total:</b>	652.01	100.00%

**Table 7. Land Cover in the Riparian Corridor of South Indian Creek and Tributaries**

Land Cover Type	Riparian Corridor Land Cover Type Area	
	Acres	Percent
Developed, Low Intensity	1.87	0.12%
Developed, Medium Intensity	2.50	0.15%
Developed, Open Space	46.42	2.88%
Cultivated Crops	13.98	0.87%
Grassland and Pasture	1125.94	69.75%
Forest	366.37	22.70%
Shrub and Herbaceous	1.51	0.09%
Wetlands	53.13	3.29%
Open Water	2.45	0.15%
<b>Total:</b>	1614.16	100.00%

## 5. Existing Loads and Needed Reductions

The *E. coli* TMDLs for North, Middle, and South Indian Creeks are represented by load duration curves that quantify the loading capacities of each water body at all possible flows. Tables 8, 9, and 10 summarize the TMDLs at selected flows and the load reductions that are needed to meet the TMDLs. The load reductions were calculated based on the geometric mean of observed *E. coli* data that exceeded the water quality criterion of 206 cfu/100 mL recorded during each selected flow regime. As shown, *E. coli* concentrations do not exceed water quality criterion during low flow conditions.

**Table 8. North Indian Creek TMDLs and Needed Reductions**

Percent of time flow is exceeded	Flow Condition	Flow (cfs)	TMDL (counts/day)	Existing Load (counts/day)	Needed Reduction (counts/day)	Needed Reduction (%)	Existing Concentration Geomean
0.95	Low flow	3.20	1.61E+10	0	0	0.00%	0
0.75	Dry conditions	8.74	4.41E+10	5.58E+10	1.18E+10	21.09%	261
0.5	Mid Range	18.86	9.51E+10	8.52E+10	0	0.00%	185
0.25	Moist Conditons	40.29	2.03E+11	2.19E+11	1.55E+10	7.11%	222
0.05	High Flow	143.85	7.25E+11	6.13E+11	0	0.00%	174

**Table 9. Middle Indian Creek TMDLs and Needed Reductions**

Percent of time flow is exceeded	Flow Condition	Flow (cfs)	TMDL (counts/day)	Existing Load (counts/day)	Needed Reduction (counts/day)	Needed Reduction (%)	Existing Concentration Geomean
0.95	Low flow	1.50	7.56E+09	0	0	0.00%	0
0.75	Dry conditions	4.10	2.07E+10	2.40E+10	3.31E+09	13.79%	239
0.5	Mid Range	8.84	4.46E+10	6.55E+10	2.09E+10	31.96%	303
0.25	Moist Conditons	18.89	9.52E+10	1.20E+11	2.50E+10	20.78%	260
0.05	High Flow	67.43	3.40E+11	4.01E+11	6.15E+10	15.33%	243

**Table 10. South Indian Creek TMDLs and Needed Reductions**

Percent of time flow is exceeded	Flow Condition	Flow (cfs)	TMDL (counts/day)	Existing Load (counts/day)	Needed Reduction (counts/day)	Needed Reduction (%)	Existing Concentration Geomean
0.95	Low flow	3.25	1.64E+10	0	0	0.00%	0
0.75	Dry conditions	8.87	4.47E+10	1.70E+11	1.25E+11	73.67%	782
0.5	Mid Range	19.14	9.64E+10	2.64E+11	1.67E+11	63.45%	564
0.25	Moist Conditons	40.88	2.06E+11	6.44E+11	4.38E+11	68.03%	644
0.05	High Flow	145.95	7.36E+11	1.30E+12	5.68E+11	43.59%	365

## 6. Point Source Implementation

Federal regulations at 40 CFR 122.44(d)(1)(vii)(B) require permit conditions to be consistent with the assumptions and requirements of TMDL wasteload allocations and other recommendations in the TMDL documents. How these conditions are expressed can vary depending upon the pollutant and nature of the discharge. Although TMDLs are required to be written for daily time increments, permit effluent limits may be written in a form that derives from and complies with applicable water quality standards that use any time measure (40 CFR 122.44(d)(1)(vii)(A) and EPA 2006). The Department's permit writers have discretion for how TMDL wasteload allocations are expressed in a permit and for determining appropriate implementation schedules. Permit writers should consult available permit writing handbooks and technical support documents to determine appropriate limits.<sup>8</sup> Although wasteload allocations are often specified for individual facilities, in some cases, it may be appropriate for pollutant loadings to be shifted between the individual facilities during permitting as long as the sum of the wasteload allocations remains unchanged and the loading capacity is not exceeded. In no case does a TMDL wasteload allocation allow for permit limits that exceed water quality standards. If water quality standard revisions result in criteria more stringent than an established TMDL wasteload allocation, then the more stringent criteria should be used in deriving the permit limits.<sup>9</sup> Information regarding the Department's permitting process is available online at [dnr.mo.gov/env/wpp/permits/index.html](http://dnr.mo.gov/env/wpp/permits/index.html) or by calling the Department's Operating Permit Section at 573-522-4502.

No portion of the TMDL loading capacity was allocated to point sources. This means that none of the point source facilities can contribute *E. coli* loads greater than *de minimis* concentrations to the impaired streams. The majority of point sources in the North, Middle, and South Indian Creek watersheds are CAFOs. All of the CAFOs in the watershed raise broiler chickens. The facilities are permitted under the Missouri general permit MO-GS1, which prohibits discharge for any reason, without exception, and any discharge is a violation. Animal waste applied on areas under the control of a CAFO are subject to conditions found in the permit, which include a nutrient management plan developed by the facility. Compliance with existing permit conditions, including the development and implementation of effective nutrient management plans, ensures that land areas under the control of the CAFO facilities where manure is applied as fertilizer will not contribute significant amounts of pollutants to streams in the North, Middle, or South Indian Creek watersheds. Nutrient management is discussed in Section 7.2.4.

## 7. Nonpoint Source Implementation

### 7.1 Nonpoint Source Management Activities Previously Implemented

The Missouri Soil and Water Conservation Program provides cost-share programs to support the reduction of *E. coli* loading in agricultural watersheds. Cost-share projects implemented in the North and South Indian Creek watersheds between 2016 and 2020 are summarized in Tables 11 and 12. Providing water systems away from streams and using fencing to exclude livestock from streams reduces direct manure inputs into water bodies, prevents soil compaction and erosion in and adjacent to streams, and allows vegetation to grow in riparian buffers. Establishing permanent vegetative cover

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<sup>8</sup> The Department maintains a Water Pollution Control Permit Manual to provide guidance to permit writing staff and is available online at [dnr.mo.gov/env/wpp/permits/manual/](http://dnr.mo.gov/env/wpp/permits/manual/). Additionally the EPA maintains a National Pollutant Discharge Elimination System (NPDES) Permit Writers' Manual online at [epa.gov/npdes/npdes-permit-writers-manual](http://epa.gov/npdes/npdes-permit-writers-manual).

<sup>9</sup> Federal regulations at 40 CFR 131.21, also known as the "Alaska Rule," require water quality standards to be approved by the EPA before they can be used for Clean Water Act purposes (i.e., water quality-based effluent limitations or TMDLs).

both in the riparian buffers and in grazing areas helps to attenuate pollutants on land so that *E. coli* and nutrient transport into streams is reduced.

**Table 11. Soil and Water Conservation Practices in the North Indian Creek Watershed**

<b>Year</b>	<b>Practice</b>	<b><i>E. coli</i> Reduction Area (Acres)</b>
<b>2016</b>	Stream protection	15.0
<b>2019</b>	Grazing System Water Distribution	139.5
	Grazing System Fence	72.1
<b>2020</b>	Grazing System Water Distribution	114.0
	Grazing System Fence	228.9
	Total	569.5

**Table 12. Soil and Water Conservation Practices in the South Indian Creek Watershed**

<b>Year</b>	<b>Practice</b>	<b><i>E. coli</i> Reduction Area (Acres)</b>
<b>2016</b>	Grazing System Water Development	296.0
	Grazing System Fence	90.0
	Grazing System Seed	100.0
	Livestock Exclusion	36.0
<b>2017</b>	Grazing System Water Development	44.0
	Grazing System Water Distribution	457.0
	Grazing System Fence	71.0
<b>2018</b>	Permanent Vegetative Cover Establishment	75.0
	Grazing System Water Development	35.0
<b>2019</b>	Grazing System Water Development and Distribution	78.5
<b>2020</b>	Permanent Vegetative Cover Establishment	61.8
	Grazing System Water Development	38.5
	Grazing System Water Distribution	9.3
	Grazing System Fence	57.4
	Total	26.2
		1,475.7

## 7.2 Potential Nonpoint Source Management Measures and Expected Load Reductions

Nonpoint source management measures should focus primarily on reducing *E. coli* and nutrient loading from grassland and pasture lands because these land cover types are most prevalent in the watersheds. Particularly in areas adjacent to the impaired water bodies or on lands susceptible to erosion. Suggested nonpoint source management measures are summarized in the following sections.

### 7.2.1 Riparian Buffers

Riparian corridor conditions have a strong influence on instream water quality. Wooded riparian buffers are a vital functional component of stream ecosystems and are instrumental in erosion

reduction, as well as the detention, removal, and assimilation of pollutants in runoff. Therefore, a stream with good riparian cover is better able to mitigate the impacts of high pollutant loads than a stream with poor or no riparian cover. Shade provided by riparian corridors is also important because it helps to keep water cooler (cold water holds more oxygen) and reduces temperature variation that stresses aquatic life especially during the critical low flows that typically occur in July and August.



Riparian corridors that lack woody vegetation should be prioritized for riparian restoration. Figures 4 and 5 display these priority riparian corridors in red. The priority riparian corridors are adjacent to approximately 31 miles of stream in the North Indian Creek watershed, 14 of which are in the Middle Indian Creek watershed, and approximately 45 miles of stream in the South Indian Creek watershed. Note that the majority of pollutants enter upstream of the impaired stream segments in tributaries to the water bodies.

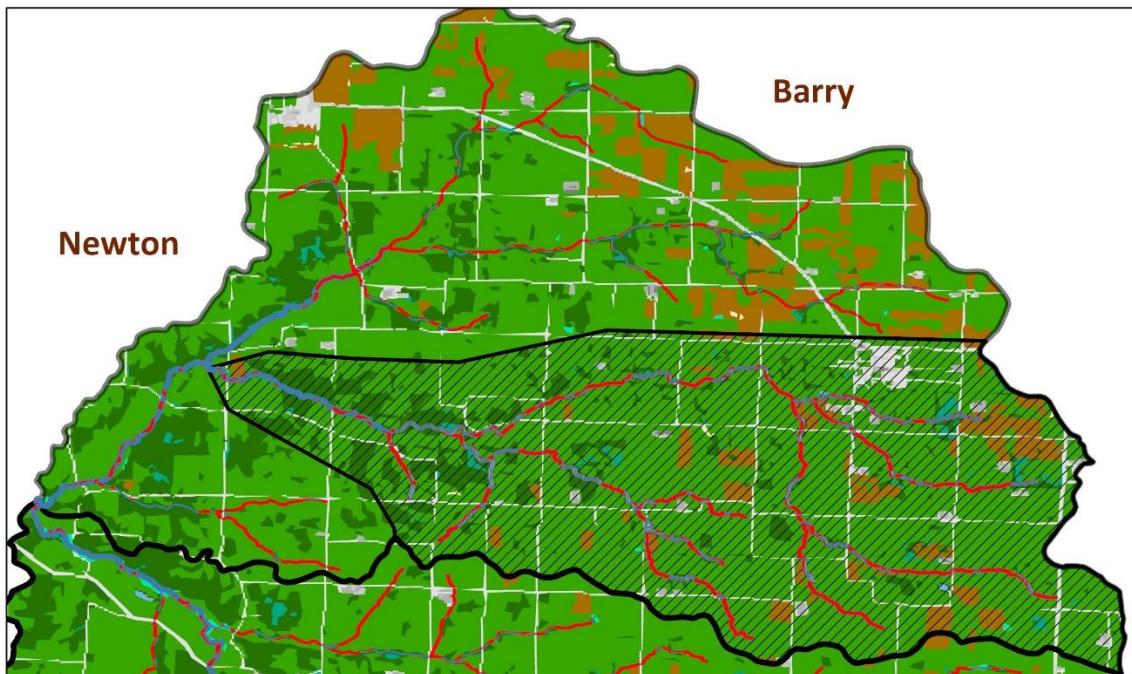
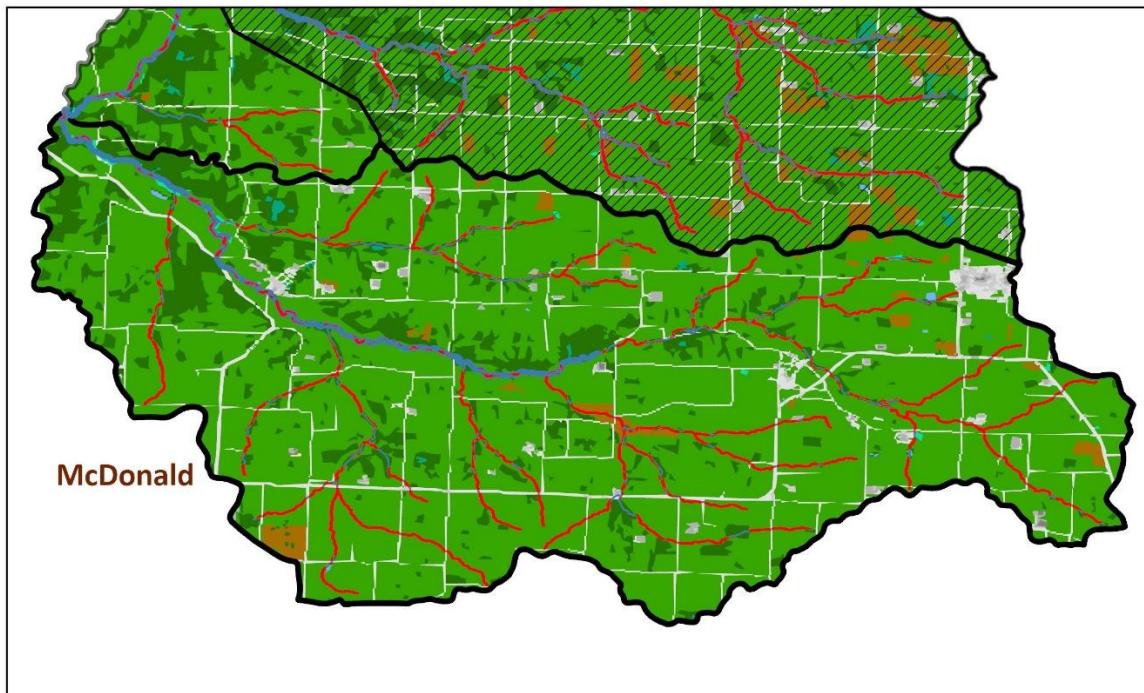


Figure 4. Land Cover and Priority Riparian Corridors adjacent to North and Middle Indian Creeks



**Figure 5. Land Cover and Priority Riparian Corridors adjacent to South Indian Creek**

### 7.2.2 Streambank Stabilization

Streambank stabilization measures also reduce erosion. Such measures may include the installation of live stakes, coconut fiber rolls and mesh, coir rolls, bank terracing, large woody debris, and large boulders to support streambanks and reduce erosion. Integrating shrub and tree planting with other bank stabilization measures results in long-term stabilization as the vegetative roots expand and provide further soil stability. Many resources are available to guide streambank stabilization design for specific conditions. A good initial reference is the *Army Corps of Engineers Streambank and Shoreline Protection Manual*

(<https://www.lrc.usace.army.mil/Portals/36/docs/regulatory/pdf/StrmManual.pdf>).





A study of bank stabilization on the Cedar River in Nebraska<sup>10</sup> (Naisargi and Mittelstet 2017) found the average streambank erosion rate before stabilization was approximately  $1.5 \text{ ft}^2/\text{ft}$  and was reduced to  $0.5 \text{ ft}^2/\text{ft}$  after stabilization measures were implemented.

### 7.2.3 Livestock Exclusion

Livestock that have access to streams reduce streamside vegetation, increase barren areas, and contribute *E. coli* and nutrients directly to streams. In addition, compaction from animals contributes to poor quality aquatic habitat because the interstitial spaces in stream substrate are eliminated. Excluding livestock from streams is another way to improve water quality and aquatic habitat in the North, Middle, and South Indian Creek watersheds.



<sup>10</sup> The Cedar River watershed is located in North Central Nebraska. The western half of the watershed is mainly grassland and sand dunes in the Sand Hills, whereas the eastern half is predominantly cropland.

#### 7.2.4 Nutrient Management

Nutrient management is the most effective strategy for reducing *E. coli* and nutrient loading from agricultural lands to streams, and is especially important in the North, Middle, and South Indian Creek watersheds due to the number of CAFOs that apply chicken manure to land in the watersheds. The *Missouri Concentrated Animal Feeding Operation Nutrient Management Technical Standard* is available online at: [dnr.mo.gov/env/wpp/permits/docs/nutrient-management-tech-standard.pdf](http://dnr.mo.gov/env/wpp/permits/docs/nutrient-management-tech-standard.pdf). The technical standard describes soil and manure testing protocols, manure application criteria including required setback distances from streams, and monitoring requirements. Department staff are available to assist CAFO operators in the development of effective nutrient management plans.



The primary goal of nutrient management is to promote biomass productivity that provides profit for producers while minimizing negative environmental impacts. Over-application of nitrogen and phosphorus above the crop needs will cause these nutrients to accumulate in the soil and increase the potential for losses to the environment. Nutrient management planning minimizes the transport of *E. coli*, nitrogen, and phosphorus to surface and ground water by optimizing fertilizer application rates, timing, and placement, as well as accounting for all sources of nutrients.

Nutrient management plans may be eligible for cost-share programs through the Soil and Water Conservation Program. Nutrient Management Plans should be developed in accordance with the NRCS Standards and Specifications for Nutrient Management (590). Landowner assistance is available through the Newton and McDonald County Soil and Water Conservation Districts.

In general, the following are required to begin nutrient management planning:

- Soil samples, based on a 7-inch depth, shall be taken once every 4 years, as a minimum, to monitor the phosphorus, potassium, pH and organic matter levels and adjust nutrient application rates as needed. The pH of the soil is important because it has a direct effect on nutrient availability. Follow Iowa State University recommendations and soil testing procedures to develop a crop budget for determining crop nutrient needs. Nitrate testing using the late spring nitrate test and fall corn stalk test can be used to monitor the nitrogen management program. Soil pH levels shall be maintained near 6.5 for corn and soybeans and 6.9 for alfalfa.
- Manure analysis could be completed on an annual basis for percent of solids, total N, organic N, NH<sub>4</sub>, P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O and pH. A more realistic nutrient content can be obtained by using the averages of three or more analysis.
- Soil tests and realistic yield potentials will be used to determine the application rate of manure so as to supply most of the crop nutrient needs through the manure and legume credits. No additional commercial phosphate or potash will be applied on soils testing high or very high in phosphorus and potassium (K). On these fields additional commercial nitrogen will be applied as needed. This will optimize crop yield potential while minimizing nutrient runoff and nitrogen leaching.
- Sensitive areas: Commercial nutrients, manure and organic by-products shall not be applied to frozen, snow covered ground or saturated soil on slopes greater than five percent unless erosion is

controlled. Manure and organic by-products shall not be applied within 200 ft. of a stream, lake, agricultural drainage well, or sinkhole unless injected or incorporated within 24 hours.

- Risk Analysis: The phosphorus index will be used to determine fields that are a high risk for phosphorus losses. Conservation and/or management practices will be used to reduce the potential for phosphorus movement off site. Soil tests will be taken every four years to determine changes in phosphorus levels.

The plan should receive periodic review to determine if adjustments or modifications are needed. At a minimum the plan will be reviewed and revised with each soil test cycle.

### 7.2.5 Cover Crops

Planting cover crops rather than leaving cultivated cropland barren has both economic and environmental benefits. Legume cover crops can reduce fertilizer costs because they contribute nitrogen to soils. Legumes such as vetch and clover convert nitrogen gas from the atmosphere into soil nitrogen that crops can use. This reduces the amount of fertilizer that needs to be purchased and applied. Applying less fertilizer to the topsoil means reduced transport of nutrients to waterbodies in the watershed. Cover crops also reduce erosion by holding soil in place and reducing top-soil crusting. The plant material left behind after cover-cropping increases water infiltration and reduces evaporation. This reduces the amount of nutrient-laden runoff, and the amount of water needed for irrigation. Moisture retention by decaying plant material also helps soils be more resilient to periodic drought conditions.



A study conducted by Zhu et al. (1989) as cited in Sharpley and Smith (1991) found that planting common chickweed, Canada bluegrass, and downy brome on Missouri soybean fields decreased water runoff by an average 44 percent. The study found that nitrogen (as nitrate) loss was reduced by an average 75 percent and soluble phosphorus runoff was reduced by an average 37 percent. Sharpley and Smith (1991) found that planting ryegrass or wheat on peanut crops for 6 months of the year reduced soil loss by an average of 83 percent.

The Missouri Parks, Soils, and Water sales tax program provides grants to cover up to 75 percent of the cost of planting cover crops, alternative crops, and vegetative buffer zones (field borders). The grants are administered through the Missouri Soil and Water Conservation Program.

### **7.2.6 Field Borders**

Field borders can provide a number of conservation benefits, such as reducing soil erosion from wind and water, protecting soil and water quality and providing habitat for wildlife. These habitats, located at the edges of crop fields, can also serve to connect other buffer practices and habitats within the agricultural landscape. The U.S. Department of Agriculture's Farm Service Agency (FSA) runs a program called the Continuous Sign-up Conservation Reserve Program (CCRP) that provides farmers with rental payments on land set-aside for conservation buffers for a period of 10-15 years. Cost-share payments are also made available to help farmers with the financial burden of establishing the buffers.



### **7.2.7 Public Outreach**

Public outreach is a key component of any watershed management plan. Measures to reduce pollutant loading from unregulated nonpoint source areas are implemented voluntarily through cooperation between citizen groups, landowners, government agencies, and funding entities. Support for nonpoint source reduction plans is generated through education and outreach activities designed to inform the public about water quality issues and what can be done to reduce pollutant loading in watersheds. The U.S. Environmental Protection Agency, U.S. Department of Agriculture, Natural Resources Conservation Service, Soil and Water Conservation Districts, Missouri Department of Natural Resources, Missouri Department of Conservation, University of Missouri Extension, and local governments produce educational materials and make them available on their websites. Staff within these agencies are available to assist with public education and provide technical support for watershed plan development.

The following are some activities recommended to develop support and participation for watershed stewardship.

1. Hold meetings and other outreach events to inform private landowners of the available technical support and financial incentives for implementing pollutant reduction strategies.
2. Attend livestock auctions and demonstrations in the local community, and hand-out literature explaining the available technical support and financial incentives for implementing pollutant reduction strategies.
3. Develop small-scale demonstrations of pollutant reduction strategies.
4. Implement a public awareness campaign regarding water quality with public service announcements.
5. Host local watershed festivals.

## 8. Measurable Milestones

Measurable milestones outline time frames for the incremental implementation of pollutant reduction strategies. Attainable milestones should be established based on available funding and stakeholder participation. For point sources, milestones may be integrated into permits as schedules of compliance to allow time to plan, fund, and construct facility upgrades or implement adaptive management. Nonpoint source pollutant reduction plans should include milestones for public outreach, attaining funding, and the implementation of chosen nonpoint source management measures. In addition, monitoring and adaptive management plans should be developed for vegetation restoration areas to ensure that plants are healthy and will grow and develop into effective *E. coli* and nutrient attenuation areas. Plans that are developed to procure Section 319 subgrants must be renewed every five years to stay eligible for funding. It is good general practice to develop measurable watershed management milestones on 5-year timeframes. Riparian buffer restoration monitoring and adaptive management plans should include annual monitoring and assessment of plant growth and development with a 5 to 7-year goal of vegetation maturity. The annual evaluations allow for adaptive management to ensure that efforts are successful. The following is an example of measurable milestones over a 20-year timeframe.

### 5-Year Milestones

- Conduct outreach, gain public participation, and explore funding options that will allow pollutant reduction strategies to be implemented.
- Develop a comprehensive watershed management plan and identify key areas for implementation.
- Procure funding and begin implementing strategies such that:
  - Nutrient management plans are developed and implemented on 10 percent of unregulated agricultural lands in the watershed, and
  - Riparian buffers, and fencing protects 10 percent of tributaries to the impaired waters.
  - 2 percent of streambanks are stabilized in key areas.
- Complete annual monitoring and adaptive management to assess the effectiveness of streambank stabilization projects and to ensure that all newly established riparian buffers are progressing toward maturity.

### 10-Year Milestones

- Continued outreach, public participation, and funding procurement.
- Develop and implement nutrient management plans on 25 percent of unregulated agricultural lands in the watershed,
- Construct riparian buffers, and fencing to protect 25 percent of tributaries to the impaired waters,
- Construct streambank stabilization in 5 percent of key areas, and
- Complete annual monitoring and adaptive management to assess the effectiveness of streambank stabilization projects and to ensure that all previously established riparian buffers are intact and newly established riparian buffers are progressing toward maturity.

#### 15-Year Milestones

- Continued outreach, public participation, and funding procurement.
- Develop and implement nutrient management plans on 50 percent of unregulated agricultural lands in the watershed,
- Construct riparian buffers, and fencing to protect 50 percent of tributaries to the impaired waters,
- Construct streambank stabilization in 7 percent of key areas, and
- Complete annual monitoring and adaptive management to assess the effectiveness of streambank stabilization projects and to ensure that all newly established riparian buffers are effectively attenuating pollutants.

#### 20-Year Milestones

- Continued outreach, public participation, and funding procurement.
- Develop and implement nutrient management plans on 75 percent of unregulated agricultural lands in the watershed,
- Construct bank stabilization, riparian buffers, and fencing to protect 75 percent of tributaries to the impaired waters,
- Construct streambank stabilization in 10 percent of key areas, and
- Complete annual monitoring and adaptive management to assess the effectiveness of streambank stabilization projects and to ensure that all previously established riparian buffers are intact and newly established riparian buffers are progressing toward maturity.

### **9. Cost-Benefit**

Cost-benefit analyses should be conducted during the watershed management planning process to determine the most efficient investments of time, effort, and supplies. Upgrades to point source facilities should consider both the immediate and necessary future capacity of the facility and should be designed based on the best available affordable technology. Costs associated with nutrient management plan implementation and cover crops are relatively minimal because many of the practices are already integrated into the farming system and substantial cost savings are achieved through reducing the need for manure application and chemical fertilizers. Streambank stabilization is the most expensive pollutant reduction strategy but can be limited to key areas to stabilize highly erosive streambanks for the benefit of water quality in all downstream waters. Table 13 provides an example of a cost-benefit summary based on the available treatment area in the total combined area of the North, Middle, and South Indian Creek watersheds, cost share estimates derived from the Department's Soil and Water Conservation Program cost share tables, and nutrient reduction rates estimated in a different watershed. The treatment acreages are based on the sample 20-year milestones in Section 8 such that nutrient management and cover crops are implemented on 75 percent of agricultural areas, 75 percent of stream area is protected by fencing and riparian buffers, and 10 percent of stream bank has been stabilized in key areas. The values in Table 13 are for example only and should be verified prior to use outside of this document. Costs can be reduced by limiting the treatment areas to headwater tributaries which will benefit all downstream waters.

**Table 13. Estimated Cost-Benefit by Practice**

<b>Practice</b>	<b>Estimated Cost Share per Acre</b>	<b>Acres</b>	<b>20-Year Total</b>	<b>TN Reduction</b>	<b>TP/<i>E. coli</i> Reduction</b>	<b>Sediment Reduction</b>	<b>Cost-Benefit Efficiency Rank</b>
Livestock Exclusion	\$180	9.2	\$1,656		Qualitative Improvement		
Riparian Buffer (25-ft each side)	\$130	345	\$44,850	1.8 %	1.3 %	0.9 %	Low
Streambank Stabilization	\$1,200	1.67	\$2,004	NA	7.5 %	24.8 %	High
Nutrient Management	\$18	37,440	\$673,920	28.0 %	31.0 %	NA	High
Cover Crops <sup>11</sup>	\$40	2,352	\$94,000	5.2 %	10.0%	9.2 %	Medium
<b>Cumulative 20-Year Total Cost Share</b>	<b>\$816,430</b>		<b>35 %</b>	<b>50%</b>	<b>35 %</b>		

## 10. Cooperating Agencies and Funding Sources

Reducing pollutant loading to achieve TMDLs often requires participation and cooperation from government agencies. TMDLs are written to meet applicable water quality standards per federal regulations at 40 CFR 130.7(c)(1). As a result, they are developed without considering citizen interest, available treatment technologies, or costs associated with nonpoint source management measures. Public service staff can assist with outreach and education, provide technical guidance, and direct interested parties to potential funding sources. Some of the available agencies and organizations and their potential roles, including funding avenues, are listed in Table 14. The list is not exhaustive and not intended to compel participation from any organization nor is it meant to exclude any who are not listed but gives a general idea of responsibilities and potential roles in watershed management. The most commonly used sources of funding are low-interest loans through the State Revolving Fund, Section 319 subgrants, and cost-share practices through the state's Soil and Water Conservation Program.

**Table 14. Agency Roles and Funding Options**

<b>Agency and Roles</b>	<b>Funding Options</b>
<b>US Department of Agriculture, Natural Resources Conservation Service</b> <a href="https://www.nrcs.usda.gov/wps/portal/nrcs/site/mo/home/">https://www.nrcs.usda.gov/wps/portal/nrcs/site/mo/home/</a>	
Financial assistance and incentives to implement voluntary best management practices (BMPs)	Environmental Quality Incentives Program (EQIP) Regional Conservation Partnership Program (RCPP) Conservation Stewardship Program (CSP) Agricultural Conservation Easement Program (ACEP)

<sup>11</sup> Parks, Soils, and Water sales tax program provides grants for 75 percent of cost.

<b>Agency and Roles</b>	<b>Funding Options</b>
<b>US Department of Agriculture's Farm Service Agency (FSA)</b> <a href="https://www.fsa.usda.gov/">https://www.fsa.usda.gov/</a> Administers a program called the Continuous Sign-up Conservation Reserve Program (CCRP) that provides farmers with rental payments on land set-aside for conservation buffers for a period of 10-15 years. Cost-share payments are also made available to help farmers with the financial burden of establishing the buffers.	Continuous Sign-up Conservation Reserve Program (CCRP)
<b>Missouri Department of Natural Resources</b> <a href="https://dnr.mo.gov/">https://dnr.mo.gov/</a>	
<b>Water Protection Program</b> <a href="https://dnr.mo.gov/env/wpp/">https://dnr.mo.gov/env/wpp/</a> Implements federal Clean Water Act regulations including: enforcing National Pollutant Discharge Elimination System (NPDES) regulations through point source facility operation permits, establishing Water Quality Standards, identifying impaired water bodies, and developing TMDLs.	Free volunteer water quality monitoring training and tools
<b>Financial Assistance Center</b> <a href="https://dnr.mo.gov/env/wpp/srf/index.html">dnr.mo.gov/env/wpp/srf/index.html</a> Provides technical guidance for publicly-owned treatment works and administers low-interest long-term loans to assist with technology and capacity upgrades. The Clean Water State Revolving Fund provides subsidized loans to municipalities, counties, public sewer districts, and political subdivisions for wastewater infrastructure projects. Loans may be paired with grant funds for qualifying communities. Information on the Department's grant policy is available online at <a href="https://dnr.mo.gov/env/wpp/srf/wastewater-assistance.htm">dnr.mo.gov/env/wpp/srf/wastewater-assistance.htm</a> . Eligible projects include new construction or improvement of existing facilities.	Clean Water State Revolving Fund
<b>Soil and Water Conservation Program</b> <a href="https://dnr.mo.gov/env/swcp/">https://dnr.mo.gov/env/swcp/</a> The Soil and Water Conservation Program (SWCP) provides financial incentives to landowners to implement practices that help prevent soil erosion and protect water quality. The program offers cost-share practices through its county conservation districts. Landowners may receive up to 75 percent reimbursement of the estimated cost of a practice through the program. The primary funding for cost-share practices from the Soil and Water Conservation Program comes from the one-tenth-of-one percent Parks, Soils, and Water Sales Tax.	SWCP cost-share
<b>Section 319 Nonpoint Source Program</b> <a href="https://dnr.mo.gov/env/swcp/nps/index.html">https://dnr.mo.gov/env/swcp/nps/index.html</a> <ul style="list-style-type: none"> <li>▪ Provides assistance with the development of watershed management plans and administers Section 319 subgrants for plan development and implementation.</li> </ul>	Section 319 subgrants

Agency and Roles	Funding Options
<b>Missouri Department of Conservation</b> <a href="https://mdc.mo.gov/">https://mdc.mo.gov/</a>	
Provides outreach, education, and technical guidance for stream and watershed management issues. Maintains Missouri Conservation lands. Issues permits for fishing and hunting.	Free volunteer water quality monitoring training and tools
<b>Missouri Agricultural and Small Business Development Authority</b> <a href="http://agriculture.mo.gov/abd/financial/awloanprg.php">agriculture.mo.gov/abd/financial/awloanprg.php</a>	
Offers an Animal Waste Treatment System Loan Program in cooperation with the Clean Water State Revolving Fund. Animal Waste Treatment Loans Program may finance eligible animal waste treatment systems for independent livestock and poultry producers with operations of less than 1,000 animals. Eligible costs include storage structures, land, dedicated equipment, flush systems, composters, and more.	Clean Water State Revolving Fund
<b>University of Missouri Extension</b> <a href="https://extension2.missouri.edu/">https://extension2.missouri.edu/</a>	
Provides guidance for farm management including crop resilience, pond health, and livestock care.	Free information and assistance
<b>County Soil and Water Conservation Districts</b> <a href="https://mosoilandwater.land/">https://mosoilandwater.land/</a>	
Provides guidance and assistance with the development of nutrient management plans and procurement of funding from the state cost-share program.	Free information and assistance with grant applications
<b>Online Databases of Additional Funding Sources</b> <ul style="list-style-type: none"> <li>▪ Wichita State University, Environmental Finance Center (EFC) Missouri Healthy Watershed Funding Search Tool <a href="https://www.wichita.edu/academics/fairmount_college_of Liberal_arts_and_sciences/hugowall/efc/news/meramec-funding-sources-landing-page.php">https://www.wichita.edu/academics/fairmount_college_of Liberal_arts_and_sciences/hugowall/efc/news/meramec-funding-sources-landing-page.php</a></li> <li>▪ Catalog of Federal Funding <a href="https://www.epa.gov/waterdata/catalog-federal-funding">https://www.epa.gov/waterdata/catalog-federal-funding</a></li> <li>▪ EPA Nonpoint Source Funding Opportunities <a href="http://water.epa.gov/polwaste/nps/funding.cfm">http://water.epa.gov/polwaste/nps/funding.cfm</a></li> <li>▪ Environmental Justice Grants <a href="https://www.epa.gov/environmentaljustice/environmental-justice-grants-and-resources">https://www.epa.gov/environmentaljustice/environmental-justice-grants-and-resources</a></li> <li>▪ Grants.gov <a href="http://www.grants.gov">http://www.grants.gov</a></li> </ul>	

## **11. Conclusion**

The ultimate goal of pollutant reduction strategies is to meet Missouri Water Quality Standards through the protection of aquatic life in warm water habitats and whole-body contact recreation. Implementation strategies should follow an adaptive approach that makes progress toward achieving water quality goals while using new data and information to reduce uncertainty and adjust implementation activities. Implementation efforts are expected to occur over a number of years, but within the schedules established in state operating permits and watershed management plans. Success in achieving water quality standards will be determined by the Department through biennial assessments of water quality compliance as required by Sections 305(b) and 303(d) of the federal Clean Water Act.

The Department maintains administrative records for the North, Middle, and South Indian Creek TMDLs. The records contain the TMDL document, this implementation strategies document, and any studies, data, or calculations upon which loading targets are based. This information is available upon request to the Department at [dnr.mo.gov/sunshinerequests.htm](http://dnr.mo.gov/sunshinerequests.htm). Any request for information about TMDLs will be processed in accordance with Missouri's Sunshine Law (Chapter 610, RSMO) and the Department's administrative policies and procedures governing Sunshine Law requests.

This implementation strategies document is scheduled for a 45-day public notice and comment period in conjunction with the comment period for the North, Middle, and South Indian Creek *E. coli* TMDL. Any comments received, as well as the Department's responses to those comments, will be maintained on file with the Department and posted online at [dnr.mo.gov/env/wpp/tmdl/3259-3260-3263-north-middle-south-indian-creek-water-body-record.htm](http://dnr.mo.gov/env/wpp/tmdl/3259-3260-3263-north-middle-south-indian-creek-water-body-record.htm). The Department maintains an email distribution list for notifying subscribers of significant TMDL updates or activities. Those interested in subscribing to these TMDL updates can submit their email address using the online form at [public.govdelivery.com/accounts/MODNR/subscriber/new?topic\\_id=MODNR\\_177](http://public.govdelivery.com/accounts/MODNR/subscriber/new?topic_id=MODNR_177).

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## **Appendix A**

### **Nine Key Elements Critical to a Watershed Management Plan**

- a. An identification of the causes and sources or groups of similar sources that will need to be controlled to achieve the load reductions estimated in this watershed-based plan (and to achieve any other watershed goals identified in the watershed-based plan, as discussed in item (b) immediately below. Sources that need to be controlled should be identified at the significant subcategory level with estimates of the extent to which they are present in the watershed (e.g., X number of dairy cattle feedlots needing upgrading, including a rough estimate of the number of cattle per facility; Y acres of row crops needing improved nutrient management or sediment control; or Z linear miles of eroded streambank needing remediation).
- b. An estimate of the load reductions expected for the management measures described under paragraph (c) below (recognizing the natural variability and the difficulty in precisely predicting the performance of management measures over time). Estimates should be provided at the same level as in item (a) above (e.g., the total load reduction expected for dairy cattle feedlots; row crops; or eroded streambanks).
- c. A description of the nonpoint source management measures that will need to be implemented to achieve the load reductions estimated under paragraph (b) above (as well as to achieve other watershed goals identified in this watershed-based plan), and an identification (using a map or a description) of the critical areas in which those measures will be needed to implement this plan.
- d. An estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon, to implement this plan. As sources of funding, States should consider the use of their Section 319 programs, State Revolving Funds, U.S. Department of Agriculture's Environmental Quality Incentives Program and Conservation Reserve Program, and other relevant Federal, State, local and private funds that may be available to assist in implementing this plan.
- e. An information/education component that will be used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the nonpoint source management measures that will be implemented.
- f. A schedule for implementing the nonpoint source management measures identified in this plan that is reasonably expeditious.
- g. A description of interim, measurable milestones for determining whether nonpoint source management measures or other control actions are being implemented.
- h. A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made towards attaining water quality standards and, if not, the criteria for determining whether this watershed-based plan needs to be revised or, if a nonpoint source TMDL has been established, whether the nonpoint source TMDL needs to be revised.
- i. A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item (h) immediately above.